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ORGANIC ICE RESISTS: EFFECT OF ELECTRON BEAM IRRADIATION ON FROZEN HYDROCARBONS

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Organic Ice Resist Lithography (OIRL) is a novel one-step method for patterning nanostructures using a thin frozen layer of beam sensitive organic material [1]. The organic vapor is introduced into the lithography instrument and condenses into a thin layer of ice on the substrate, which is held at cryogenic temperature. After exposure to the scanning electron beam, the substrate is heated up to room temperature and unexposed ice sublimates (Fig 1 (a)). Exposed areas are transformed into non-volatile product by the electron beam and remain on the substrate. In order to understand beam exposure mechanism in organic ices, we have patterned simple linear hydrocarbons (N-alkanes) with different molecular weights (Fig 1(b)) in an environmental transmission electron microscope (ETEM) operated at 80 kV in scanning mode. The experiments revealed that the feature size depends on the precursor molecular weight. Coupling this result with the experimental contrast curves of each precursor (exposed thickness vs. dose) led to a model connecting crosslinking in exposed ice and its phase transformation from volatile to non-volatile state.

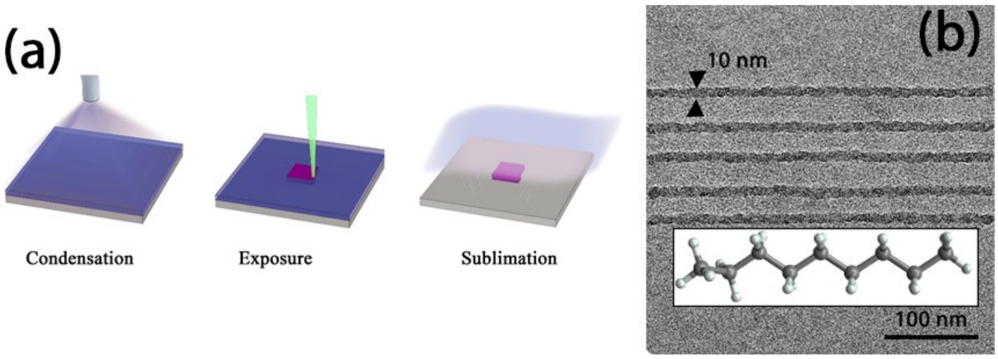

Figure 1. (a) General principle of OIRL. (b) Patterned 10-nm lines on n-nonane organic ice.

References:

[1] W. Tiddi *et al.*, Nano Letters **17**, 7886 (2017)